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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/782,558	02/13/2001	Carlo Rubbia	P-6150	9660

7590 03/18/2004

Michael L. Kenaga  
Piper Marbury Rudnick & Wolfe  
P.O. Box 64807  
Chicago, IL 60664-0807

EXAMINER

PALABRICA, RICARDO J

ART UNIT	PAPER NUMBER
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3641

DATE MAILED: 03/18/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/782,558

Applicant(s)

RUBBIA, CARLO

Examiner

Rick Palabrica

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 02 January 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 25-31, 33, 36-45, 47-70 and 72-98 is/are pending in the application.
- 4a) Of the above claim(s) 30, 31, 56 and 57 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 25-29, 33, 36-45, 47-50, 52-55, 58-70 and 72-98 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

### DETAILED ACTION

1. Applicant's 1/2/04 Request for Continued Examination (RCE) and associated Amendment D, which directly amended claims 25, 27, 49, 53, 74, 76, 84, 91, 94 and added new claims 95-98, are acknowledged. This amendment is in response to the 10/1/03 Office Action.

2. Applicant traversed the use of Bingham et al. in the rejection of claims in the 10/1/03 Office Action. Applicant's arguments have been fully considered but they are not persuasive.

In the Remarks section on page 14 of Amendment D, Applicant alleges that the Examiner reads Bingham et al.'s sentence regarding the coating of the cylinder material with fuel, "out of context." He states that the Bingham et al. process includes depositing a protective carbon layer and a final protective layer of zirconium carbide. As such, these protective layers act as a barrier that block the released fission fragments from reaching the medium in the central bore of the fuel element. The Examiner disagrees because Bingham et al. clearly states that as an alternative embodiment, the protective coatings cited by the Applicant may be deleted. See column 3, lines 35+. Therefore, for this alternative embodiment, there is no barrier to the fission products and they can have the claimed direct contact with the gaseous medium.

### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

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The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claim 86 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

A broad range or limitation together with a narrow range or limitation that falls within the broad range or limitation (in the same claim) is considered indefinite, since the resulting claim does not clearly set forth the metes and bounds of the patent protection desired. Note the explanation given by the Board of Patent Appeals and Interferences in *Ex parte Wu*, 10 USPQ2d 2031, 2033 (Bd. Pat. App. & Inter. 1989), as to where broad language is followed by "such as" and then narrow language. The Board stated that this can render a claim indefinite by raising a question or doubt as to whether the feature introduced by such language is (a) merely exemplary of the remainder of the claim, and therefore not required, or (b) a required feature of the claims. Note also, for example, the decisions of *Ex parte Steigewald*, 131 USPQ 74 (Bd. App. 1961); *Ex parte Hall*, 83 USPQ 38 (Bd. App. 1948); and *Ex parte Hasche*, 86 USPQ 481 (Bd. App. 1949). In the present instance, claim 86 recites the broad recitation of a fissile content lower than  $10 \text{ mg/cm}^2$ , and the claims also recite preferably in the range 1 to  $3 \text{ mg/cm}^2$ , which is the narrower statement of the range/limitation.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Arino et al. (U.S. 3,940,318) in view of Wheeler (U.S. 3,974,028) and Etherington (Nuclear Engineering Handbook). Arino et al. disclose the applicant's claim except for the reflector thickness.

Arino et al. disclose a primary target for production of radioactive fission products such as  $^{99}\text{Mo}$  in a nuclear reactor. The target has a thin, continuous, uniform layer of fissionable material, integrally bonded to its inner walls and a port permitting access to the interior of the vessel (see column 1, lines 10+). Arino et al. teaches that his apparatus has the advantage of producing  $^{99}\text{Mo}$  of high yield and high specific activity (see column 3, lines 1+).

Applicant's claim language reads on Arino et al.'s invention (see Figure) as follows: a) "open chamber having a wall with front face coated with fissile material and a rear face" reads on primary target 10 having a layer of fissionable material; b) "inlet means for introducing gas into the chamber" reads on port 12; c) "outlet means for evacuating gas" reads on port 12; d) "gas" reads on the trapped air or residual helium gas inside target 10 (see column 7, lines 12+). Note that the limitation regarding an "open chamber" is met when port 12 is open.

Arino et al. also disclose that there is intimate contact of the fissionable material with the inner walls of the vessel and optimum heat transfer to the coolant during

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exposure of the primary target to radiation. This statement indicates that the chamber is cooled when irradiated in a reactor.

Wheeler teaches a reactor surrounded with graphite reflector 2 (see Fig. 1). Wheeler is an example of a reactor that can provide neutron irradiation to Arino et al.'s target. As to the limitation regarding the reflector having a thickness of at least  $50/d$ , where  $d$  = density of carbon material, this yields a thickness of at least 22 cm, based on a graphite density of  $2.22 \text{ gm/cm}^3$ . As stated in the 5/7/03 Office Action, Etherington teaches that graphite has a thermal diffusion length = 51.8 cm (see Table 24, page 1-20). Both carbon (in the form of graphite) and beryllium are well-known neutron reflector materials. In the 4/17/02 Office Action, the Examiner also stated that it is well known in the nuclear art that a reflector should have a thickness of at least one thermal diffusion length in order to be effective, and to use a 51.8 cm thickness for the graphite reflector would have been prima facie obvious.

As to the limitation regarding the gas "circulating through the chamber", note that when the target is irradiated in a reactor, such as Wheeler's, there is inherently some non-uniform heating of the trapped gas that would result in the claimed gas circulation.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the apparatus, as disclosed by Arino et al., to deploy it in a reactor, as taught by Wheeler, to have a gas heating device having a neutron reflector of at least  $50/d$ , to gain the advantages thereof (i.e., produce a radioisotope of high specific activity), because such modification is no more than the use of a well-known expedient for radioisotope production within the nuclear art.

Note that the elements of said claim reads on the Arino et al. - Wheeler device, and it must also inherently function in the same manner to produce the same results as applicant's gas heating device. As to limitations which are considered to be inherent in a reference, note the case law of In re Ludtke, 169 USPQ 563, In re Swinehart, 169 USPQ 226, In re Fitzgerald, 205 USPQ 594, In re Best et al., 195 USPQ 430, and In re Brown, 173 USPQ 685, 688.

5. Claims 25, 26, 28, 29, 33, 36-39, 42-45, 49, 50, 52, 54, 55, 58-64, 67-70, 74, 75, 77-81, 84, 85, 87, 88, 91 and 93 are rejected under 35 U.S.C. 103(a) as being unpatentable over Culver (U.S. 5,873,239) in view of Bingham et. al (U.S. 4,759,911) and Etherington (Nuclear Engineering Handbook). Culver discloses the applicant's claims except for the fissile material-coated chamber and the reflector.

Culver discloses a nuclear rocket engine comprising a gas heating device (Fig. 1) including at least one chamber for containing gas, i.e., hollow fuel assembly (48), means for cooling the rear face of the chamber (see coolant flow on the outer surface of fuel assembly, and a means for expelling the heated gas into space to generate thrust (see nozzle 10). Culver further discloses (see Fig. 4) a neutron reflector (52) surrounding the enclosure of the gas heating device, said reflector having cavities for receiving removable neutron-absorbing control rods (see numeral 76 and column 5, lines 55+). Culver uses a gaseous hydrogen propellant (see column 8, lines 65+) and beryllium reflector (see column 5, lines 58+). Culver further discloses a chamber cooling

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circuit that is separate from the propellant circuit, said "means for cooling the chamber" as being located at a "rear face" of said chamber (e.g., numeral 34, Fig. 2).

Culver does not disclose details about the fuel assemblies but teaches that they are of conventional construction (see column 4, lines 60+). Bingham et. al disclose a gas-cooled fuel element for space power and propulsion applications (see column 1, lines 10+). They teach that their fuel element provides optimum power density (see column 1, lines 66+ and column 2, lines 13+). Bingham et. al show this fuel element in their figure as a cylinder wherein americium carbide is coated on the cylinder base material (see column 2, lines 40+). Applicant's claim language "chamber" reads on Bingham et. al's cylindrical base material.

One having ordinary skill in the art would have recognized that Bingham et al.'s fuel element is well known in the nuclear rocket art, i.e., it is conventional, and advantageous because of its optimum characteristics.

As to the limitation regarding the reflector having a thickness of at least  $50/d$ , where  $d$  = density of carbon material, this yields a thickness of at least 22 cm, based on a graphite density of  $2.22 \text{ gm/cm}^3$ . As stated in the 5/7/03 Office Action, Etherington teaches that graphite has a thermal diffusion length = 51.8 cm (see Table 24, page 1-20). Both carbon (in the form of graphite) and beryllium are well-known neutron reflector materials. In the 4/17/02 Office Action, the Examiner also stated that it is well known in the nuclear art that a reflector should have a thickness of at least one thermal diffusion length in order to be effective, and to use a 51.8 cm thickness for the graphite reflector would have been prima facie obvious.



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Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the nuclear rocket, as disclosed by Culver, by the teaching of Bingham et. al and Etherington, to gain the advantages thereof (e.g., optimum power density), in order to have a space engine, comprising: a) at least one open chamber having a wall, said wall having a front face coated with an americium carbide fissile material and a rear face; b) inlet means for introducing gas into the chamber; c) outlet means for evacuating gas circulated through said chamber from the inlet means; d) a neutron reflector comprising a thickness of at least 50/d cm; e) means for cooling the rear face of the chamber, as this no more than the use of a well-known fuel material and reflector configuration in the nuclear rocket art. See also the discussion in section 5 above regarding Bingham et al.

The claims are replete with statements that are either essentially statements of intended or desired use, e.g., the whereby clause discussed above, "for receiving removable neutron-absorbing control rods, "for receiving the heated gas," etc. These clauses, as well as other statements of intended use do not serve to patently distinguish the claimed structure over that of the reference, as long as the structure of the cited references is capable of performing the intended use. See MPEP 2111-2115.

See also MPEP 2114 that states:

A claim containing a "recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus" if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647.

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Claims directed to apparatus must be distinguished from the prior art in terms of structure rather than function. In re Danly, 263 F.2d 844, 847, 120 USPQ 528, 531.

[A]pparatus claims cover what a device is, not what a device does." Hewlett-Packard Co. v. Bausch & Lomb Inc., 15 USPQ2d 1525, 1528.

As set forth in MPEP 2115, a recitation in a claim to the material or article worked upon does not serve to limit an apparatus claim.

The system cited above is capable of being used in the same manner and for the intended or desired use as the claimed invention.

6. Claims 27, 53, 76, 86 and 94-98 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Culver - Bingham et. al - Etherington combination, as applied to claims 25, 26, 28, 29, 33, 36-39, 42-45, 49, 50, 54-56, 58-64, 67-70, 74, 75, 77-81, 84-88, and 91 and further in view of IDS document C2, Chikin et al. "Gas Heating by Fission Fragments in the Channel of a Pulsed Reactor," Atomnaya Energiya, December 1988, USSR, Vol. 65, No. 6). The combination as discussed above in section 9 discloses the applicant's claims except for the specifics on the thickness of the fissile material.

As to the limitation in said claims of having a fissile content of lower than 10 mg/cm<sup>3</sup>, Chikin discloses a gas-filled channel of a pulsed reactor wherein a layer of highly enriched nuclear fuel (90% <sup>235</sup>U) of thickness 2.5 microns is applied to the inner surface of the graphite wall of said channel. Based on a density of uranium carbide = 10.9 gm/cm<sup>3</sup> (e.g., see Handbook of Chemistry and Physics, Hodgman et al., pages 678-679), the thickness of the nuclear fuel is equivalent to 2.8 mg/cm<sup>2</sup>.

One having ordinary skill in the art would have recognized that the fuel elements of Chikin et al. is similar to that of Bingham et al., i.e., uranium carbide on a wall of

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graphite (see Abstract of Chikin and column 3, lines 10+ of Bingham et al.). Therefore, modification of the cited combination to have included the teaching of Chikin would have been obvious to one having ordinary skill in the art at the time the invention was made, as such results are in no more than utilization of known techniques in the nuclear art, and the substitution of one well-known embodiment of a nuclear fuel element by another well-known element.

7. Claims 40, 41, 47, 48, 65, 66, 72, 73, 82, 83, 89, 90, 92 and 93 are rejected under 35 U.S.C. 103(a) as being unpatentable over the Culver - Bingham et. al - Etherington combination, as applied to claims 25, 26, 28, 29, 33, 36-39, 42-45, 49, 50, 54-56, 58-64, 67-70, 74, 75, 77-81, 84-88, and 91.

As stated by the Examiner in the 4/17/02 Office Action, the limitation in said claims regarding the use of  $^7\text{Li}$  as coolant is a well-known expedient in the nuclear art because of its good heat-absorbing capacity and its low molecular weight. The applicant did not seasonably traverse statement, and therefore, this object of the well-known statement are taken to be admitted prior art. See MPEP 2144.03. Accordingly, the use  $^7\text{Li}$  as a substitute coolant for hydrogen in the Culver - Bingham et. al - Etherington combination would be prima facie obvious.

### **Conclusion**

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. References C-E further illustrate prior art.

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9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rick Palabrica whose telephone number is 703-306-5756. The examiner can normally be reached on 7:00-4:30, Mon-Fri; 1st Friday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Carone can be reached on 703-306-4198. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

RJP  
3/15/04



MICHAEL J. CARONE  
SUPERVISORY PATENT EXAMINER